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(54) **SCALING REDUCTION IN A BOILER USED IN A SURFACE CLEANING APPARATUS**

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A47L 13/22 (2006.01)
F22B 1/28 (2006.01)

(52) **U.S. Cl.**

CPC ***B08B 3/00*** (2013.01); ***A47L 13/225*** (2013.01); ***F22B 1/282*** (2013.01); *B08B 2230/01* (2013.01)

(58) **Field of Classification Search**

CPC B08B 2230/01; B08B 3/00; F22B 1/282; A47L 13/228

See application file for complete search history.

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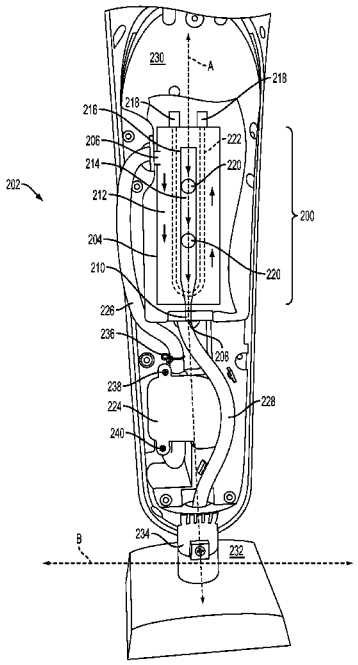
(57) **ABSTRACT**

A steam generator for a surface cleaning apparatus is described. The steam generator includes: a first chamber for generating steam and collecting scale; a water inlet disposed proximate a first end of the first chamber; a heater in thermal contact with the first chamber; a second chamber housed within the first chamber and in fluid communication with the first chamber; and a steam outlet for releasing steam and in fluid communication with the second chamber, wherein the steam outlet is disposed distal to the first end of the first chamber.

17 Claims, 3 Drawing Sheets



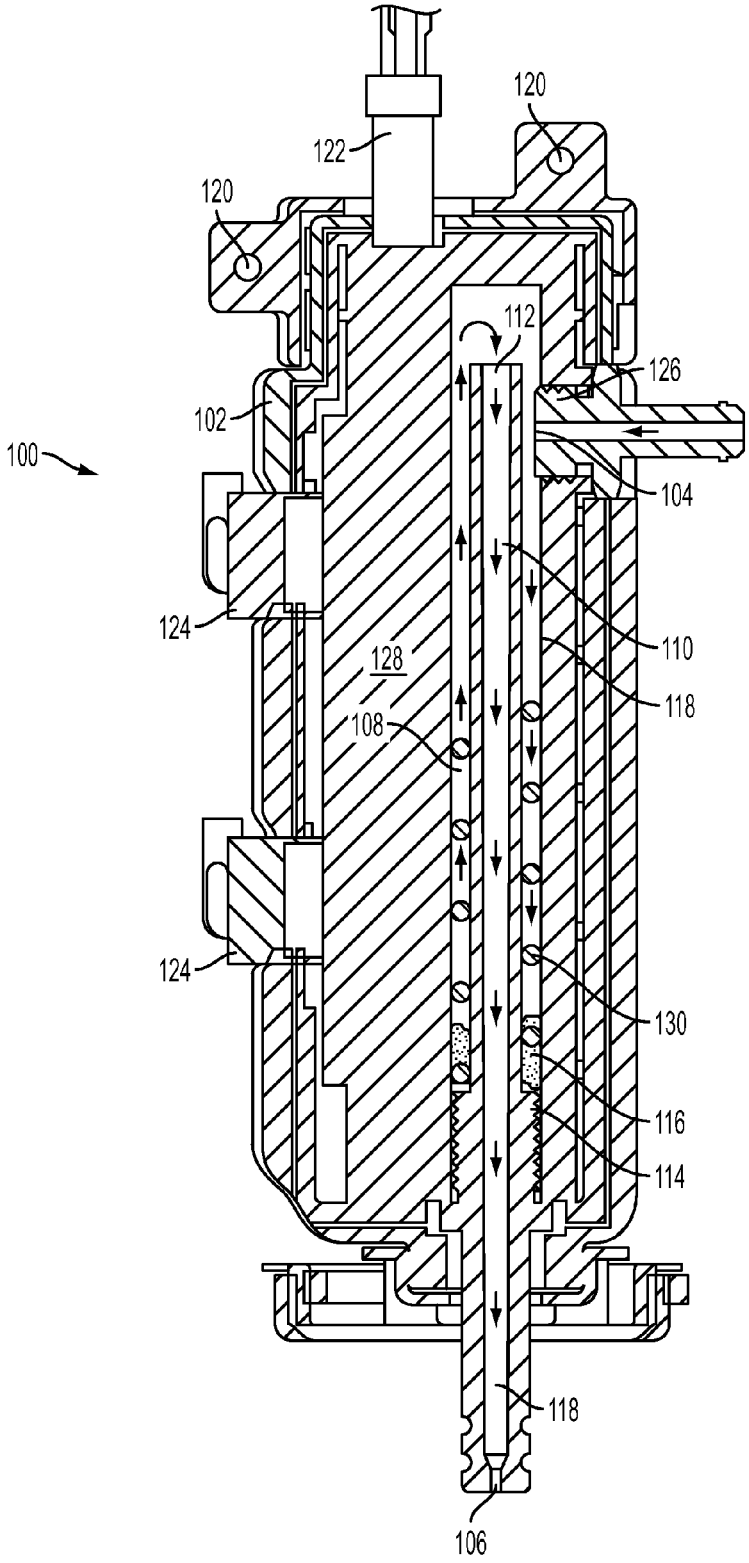

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FIG. 1

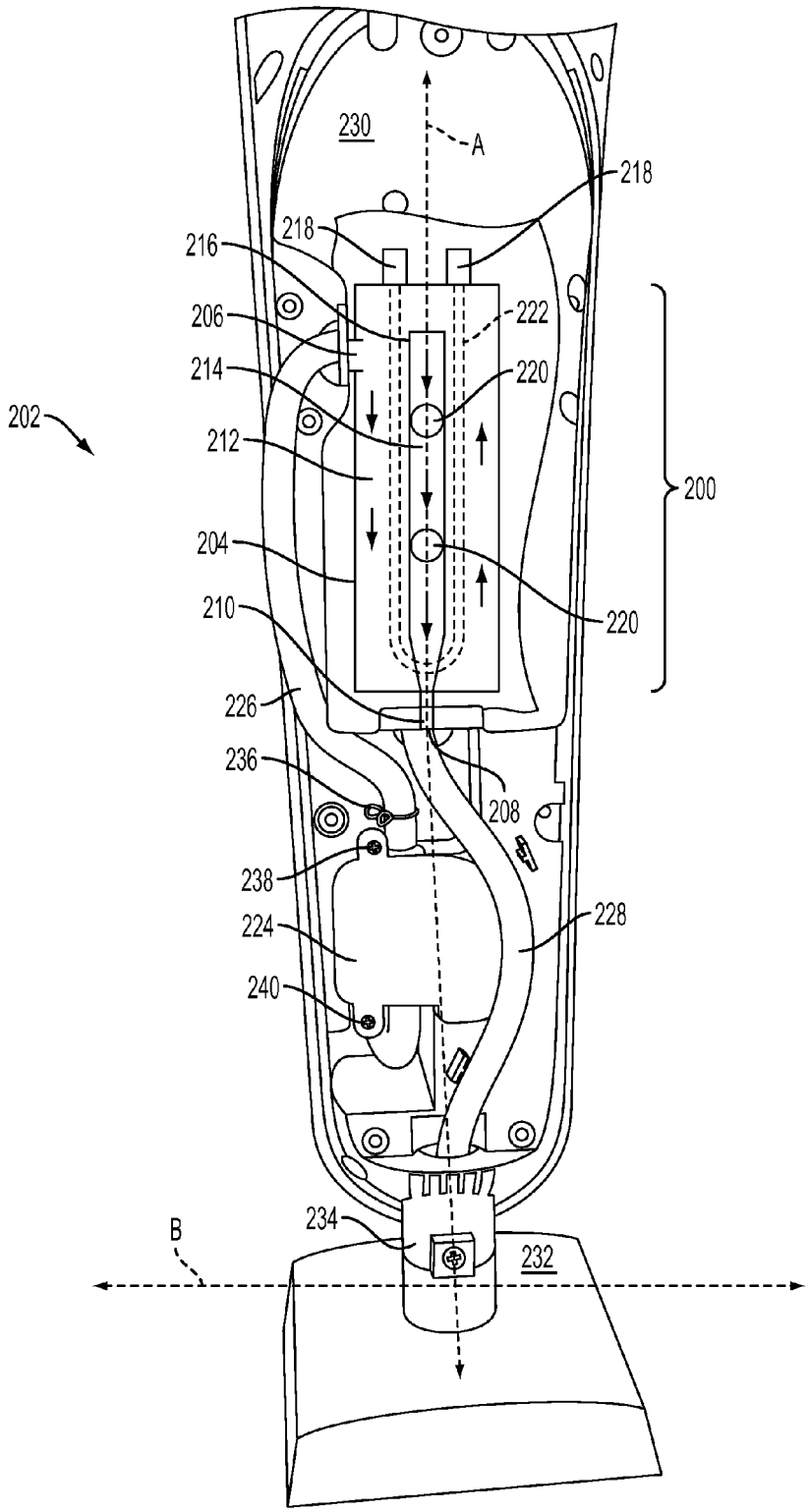
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FIG. 2

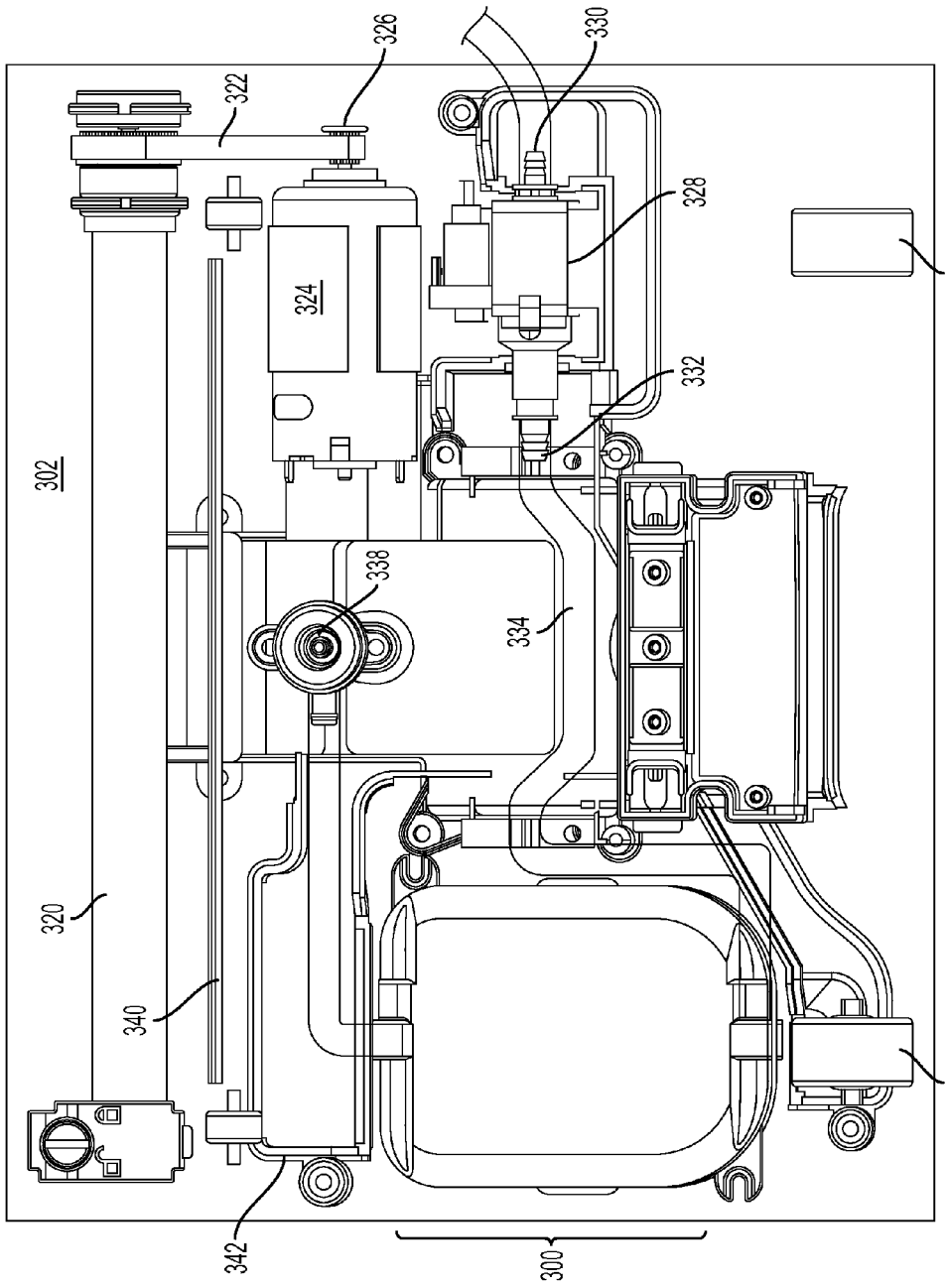

FIG. 3

SCALING REDUCTION IN A BOILER USED IN A SURFACE CLEANING APPARATUS

TECHNICAL FIELD

The present teachings are directed toward the improved cleaning and durability capabilities of steam generating surface cleaners.

BACKGROUND

A need has been recognized in the surface cleaning industry for steam generating surface cleaner that has increased longevity. A requirement for many steam generating appliances is the use of distilled water in order to prevent scale buildup within a boiler. Prior art boilers and steam generators have a single internal chamber for generating steam. Distilled water is free of any contaminates or particulates, and thus does not produce scale within the boiler. Failure to use distilled water in prior art boilers produces scale within the boiler, eventually leading to clogged outlets, and reduced efficiency and performance. Because a consumer must purchase and store distilled water in order to properly utilize a steam generating vacuum cleaner, such units have increased expense and inconvenience associated with their use. As such, there exists a need for a steam generating surface cleaner that can reduce scale buildup thereby increasing the longevity of the steam cleaning appliance while reducing the operational costs associated with use of the surface cleaner.

Other deficiencies in the prior art can be inferred by the disclosure herein.

SUMMARY

According to one embodiment, a steam generator for a surface cleaning apparatus is described. In some embodiments, the steam generator comprises a first chamber for generating steam and collecting scale, a water inlet disposed proximate a first end of the first chamber, a second chamber housed within the first chamber and in fluid communication with the first chamber, and a steam outlet for releasing steam and in fluid communication with the second chamber, wherein the steam outlet is disposed distal to the first end of the first chamber.

In some embodiments, the water inlet is substantially orthogonal to the first chamber. In some embodiments, the first chamber is substantially cylindrical in shape. In some embodiments, the second chamber is substantially cylindrical in shape. In some embodiments, the first chamber comprises a non-corrosive heat conductor. In some embodiments, the second chamber comprises a non-corrosive heat conductor.

In some embodiments, the steam generator further comprises a heating element disposed in contact with the first chamber. In some embodiments, the steam generator further comprises a temperature sensor to sense the operating temperature of the first chamber, wherein power is removed from the heating element when the operating temperature exceeds a threshold.

In some embodiments, the steam generator further comprises a water pump, and a temperature sensor to sense the operating temperature of the first chamber, wherein power is supplied to the water pump when the operating temperature exceeds a threshold.

In some embodiments, the steam generator further comprises a thermal insulator disposed around the first chamber.

According to various embodiments, a steam generator for a surface cleaning apparatus is described. In some embodiments, the steam generator comprises a first chamber for generating steam and collecting scale, a water inlet disposed proximate a first end of the first chamber, and a conduit disposed within the first chamber and including a steam inlet disposed proximate a first end of the conduit, and a steam outlet disposed proximate a second end distal from the first end, wherein the steam outlet is disposed outside the first chamber, and the first end of the conduit is disposed proximate the water inlet.

In some embodiments, the steam generator is disposed vertical to a cleaning surface. In some embodiments, the multi-chamber steam generator is horizontal to a cleaning surface. In some embodiments, the multi-chamber steam generator further comprises a water inlet and a steam outlet. In some embodiments, the steam generator further comprises a water pump, wherein a water pump outlet of the water pump is fluidly connected to a water inlet of the multi-chamber steam generator.

In some embodiments, the water pump outlet is vertically below the water inlet. In some embodiments, the cleaning apparatus further comprises a water reservoir. In some embodiments, the water reservoir is vertically above the water pump. In some embodiments, the pump is a self-priming pump. In some embodiments, the pump is a metered pump. In some embodiments, the surface cleaning apparatus further comprises a beater bar housing, a beater bar for agitating a cleaning surface, and a debris collection unit for collecting debris from the cleaning surface, wherein the debris collection unit is fluidly connected to the beater bar housing.

In some embodiments, the beater bar is driven by a motor. In some embodiments, the surface cleaning apparatus further comprises wheels, wherein the beater bar is driven by the frictional force of the wheels on the cleaning surface. In some embodiments, the surface cleaning apparatus further comprises a temperature sensor. In some embodiments, the temperature sensor turns on a pump when a minimum temperature within the multi-chamber steam generator is reached. In some embodiments, the temperature sensor shuts of power to a heating element when a maximum temperature within the multi-chamber steam generator is reached.

BRIEF DESCRIPTION OF THE DRAWINGS

The same reference number represents the same element on all drawings. It should be noted that the drawings are not necessarily to scale. The foregoing and other objects, aspects, and advantages are better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

FIG. **1** illustrates a cross section of one embodiment of a steam generator;

FIG. **2** illustrates the interior of the body of an upright vacuum cleaner having a steam generator according to one embodiment; and

FIG. **3** illustrates the interior of the base of an upright vacuum cleaner having a steam generator according to one embodiment.

DETAILED DESCRIPTION

The present teachings provide a steam generator for a surface cleaner capable of providing improved cleaning features and longevity. The structure of a steam generator can comprise an inlet, a body with an internal chamber, and an outlet. A second chamber, housed within the first chamber, prevents the accumulation of scale within the outlet, thereby

increasing the longevity of the steam cleaner, reducing costs associated with use and maintenance for a consumer.

FIG. **1** illustrates an exemplary embodiment of a steam generator **100**. A steam generator housing **102** may contain a first chamber **108** and a second chamber **110**. Water may flow into a steam generator **100** via water inlet **104**, where the water flows into first chamber **108** and is heated into steam. As the steam rises within chamber **108**, pressure builds in chamber **108**. Eventually the steam is forced into second chamber **110** at second chamber steam inlet **112**. Steam may exit steam generator **100** by passing through second chamber outlet passage **118**. Second chamber outlet passage **118** can include a tip that is narrow in diameter at outlet **106**. During the evaporation of water into steam within first chamber **108**, any contaminants, particulates, or mineral; deposits may be released from the water to form a scale **116**. The scale **116** falls out of the water and may accumulate at the bottom and along the side walls of first chamber **108**. Thus, steam, free from any contaminants, enter second chamber steam inlet **112** and exits outlet **106**. As such, the scale **116** is generally disposed off in chamber **108** and scale **116** does not clog outlet **106**. Contaminant free steam may be delivered to a mop head or a steam nozzle where it can be used to clean a surface of interest. In some embodiments, the mass or surface area of a heated surface can be increased within first chamber **108**. This can be accomplished by disposing a spring **130** around second chamber **110**, or by disposing other non-corrosive heat conductive materials shaped as spheres, rings, powders etc. within first chamber **108**. The increased surfaces, thereby allowing more efficient steam generation and increasing the efficiency of the removal of contaminants from the water.

Water, flowing into steam generator **100**, may be transformed into steam by heat generated by heater **122** embedded within a heater block **128**. Electrical power may be supplied to heater **122**. In some embodiments, heater **122** may include a resistance heating element, such as a wire, coil, ribbon, screen, foil, heat lamp or ceramic element. The heating element may comprise kanthal, nichrome, cupronickel, molybdenum dicilide, ceramic insulated metal, of PTC ceramic, or mixtures thereof.

Temperature sensors **124** may detect temperatures of first chamber **108** and second chamber **110**. Temperature sensors **124** may be connected to a monitoring circuit (not shown) such that if an internal temperature of first chamber **108** and/or second chamber **110** is exceeded, power to a heater, pump, or other component of surface cleaner is turned off. In some embodiments, temperature sensors **124** may be connected to a monitoring circuit (not shown) such that if a minimum temperature is reached, power to a pump, beater bar, or other component of the surface cleaner is turned on. Temperature sensors **124** can be in thermal contact with heater block **128**.

Housing **102** may be a single integrated unit or may contain multiple parts pieced together to form housing **102**. For example, housing **102** may include an inlet receiving portion to receive threads **126** on inlet **104**. As such, a conduit, for example, from a water reservoir, can be secured to inlet **104**. In some embodiments, outlet **106** may include threads **114** which allows second chamber **110** and second chamber outlet passage **118** to be secured into housing **102** within first chamber **108**. In some embodiments, housing **102** may comprise two halves. The two halves may be secured together via fasteners (not shown) which may be received in fastener receivers **120**. In some embodiments, fastener receivers **120** receive fasteners which secure steam generator into a surface cleaner. In some embodiments, the whole unit may be die cast. In some embodiments, housing **102** comprises a heat conducting material. For example, in some embodiments, housing **102** can comprise aluminum, steel, or other suitable materials, or combinations thereof.

In some embodiments, first chamber **108** and second chamber **110** comprise heat conductive material that is resistant to rust. In some embodiments, first chamber **108** and second chamber **110** are made from the same materials. In some embodiments, first chamber **108** is a different material than second chamber **110**. In some embodiments, first chamber **108** and/or second chamber **110** comprise brass, copper, stainless steel, polytetrafluoroethylene (i.e., Teflon), or other suitable materials, mixtures thereof. In a preferred embodiment, second chamber **110** comprises Teflon.

FIG. **2** illustrates an embodiment of a steam generator in a surface cleaner. In this embodiment, steam generator **200** is secured within the body portion of an upright floor cleaner **202**. A water reservoir (not shown) supplies water to a pump **224**. Hose **226** may allow water to travel from pump to steam generator inlet **206**. Water enters first chamber **212**, where the water becomes steam, the steam travels to second chamber steam inlet **216**. Steam then travels through second chamber **214**, through second chamber outlet passage **210**, and out of steam generator **200** via outlet **208**. Hose **228** conducts steam from steam generator to a steam applicator, for example, a cloth mop or a nozzle. Hose **228** and/or hose **226** may be secured to various inlets or outlets via locking pins **236** or other fasteners as known in the art.

Water, flowing into steam generator **200**, may be transformed into steam by heat generated by heating elements **222** embedded within steam generator interior portion. Power may be supplied to heating elements **222** via connectors **218**. In some embodiments, heating elements **222** may include a resistance heating element, such as a wire, coil, ribbon, screen, foil, heat lamp, or ceramic element. The heating elements **222** may comprise kanthal, nichrome, cupronickel, molybdenum dicilide, ceramic insulated metal, of PTC ceramic, or mixtures thereof.

Temperature sensors **220** may detect temperatures of first chamber **212** and second chamber **214**. Temperature sensors **220** may be connected to a monitoring circuit (not shown) such that if an internal temperature of first chamber **212** and/or second chamber **214** is exceeded, power to heating element **222** is turned off. In some embodiments, temperature sensors **220** may be connected to a monitoring circuit (not shown) such that if a minimum temperature is reached, power to pump **224** is turned on.

In this embodiment, steam generator **200** is located within a floor surface cleaning machine **202**. Floor surface cleaning machine **202** may have a surface cleaner housing and a base portion **232** which are connected at pivot point **234**. Although not shown, floor surface cleaning machine may include a handle, power cords, circuit boards, a water reservoir, motors, dust collecting chambers (or bags), beater bars, brushes, hand held attachments, etc. In some embodiments, floor surface cleaning machine utilized removable cloth pads to clean the surface.

In this embodiment, pump **224** is located below steam generator **200** along axis A. In some embodiments, pump **224** is located below a water reservoir. In such embodiments, gravity may prime pump **224** with water from the water reservoir. In some embodiments, pump **224** is a self priming pump. In some embodiments, pump **224** is a metered pump. In some embodiments, first chamber **212** and/or second chamber **214** of steam generator **200** are disposed along axis A. As such, first chamber **212** and/or second chamber **214** of steam generator **200** are substantially orthogonal to the surface to be cleaned as depicted by axis B.

FIG. **3** illustrates steam generator **300** within the housing **342** of a floor cleaner base **302**. In this embodiment, water flows from a water reservoir (not shown) and into pump inlet **330**, through pump **328**, through water hose **334**, and into steam generator. Steam generated in steam generator **300** travels through a conduit and out of the floor cleaner base **302** at nipple **338**. In some embodiments, floor cleaner base includes motor assembly **324** and motor shaft **326**, which drives beater bar **320** via flexible belt **322**. In some embodiments, floor cleaner base **302** includes wheels **336**. For example, in some embodiments, the floor cleaner includes a beater bar housing, beater bar **320** for agitating a cleaning surface, and a debris collection unit for collecting debris from the cleaning surface, wherein the debris collection unit is fluidly connected to the beater bar housing.

In some embodiments, the steam generators are in any shape suitable for generating steam. In some embodiments, the steam generator may be substantially cylindrical, cuboidal, conical, rectangular, or spherical in shape. In some embodiments, the first chamber is substantially the same shape as the second chamber. In some embodiments, the first chamber has a different shape than the second chamber. For example, the first chamber may be substantially conical while the second chamber is substantially cylindrical in shape.

Combinations of different features illustratively described in connection with the embodiments are also contemplated. Although the embodiments illustrated herein relate steam generators in a floor cleaner, alternative surface cleaner configurations (e.g., hand held, canister, etc.) are also contemplated.

The various embodiments described above are provided by way of illustration only and should not be constructed to limit the invention. Those skilled in the art will readily recognize the various modifications and changes which may be made to the present invention without strictly following the exemplary embodiments illustrated and described herein, and without departing from the true spirit and scope of the present invention, which are set forth in the following claims.

What is claimed is:

1. A surface cleaning apparatus comprising:

a steam generator comprising:

a first chamber for generating steam and collecting scale,

a water inlet disposed proximate a first end of the first chamber,

a heater in thermal contact with the first chamber,

a second chamber housed within the first chamber and in fluid communication with the first chamber,

a steam outlet for releasing steam and in fluid communication with the second chamber, wherein the steam outlet is disposed distal to the first end of the first chamber;

a water reservoir in fluid communication with the water inlet; and

a spring circumferentially disposed around the second chamber.

2. The surface cleaning apparatus of claim **1** further comprising a pump in fluid communication with the water inlet and the water reservoir.

3. The surface cleaning apparatus of claim **1**, further comprising:

a beater bar housing;

a beater bar for agitating a cleaning surface; and

a debris collection unit for collecting debris from the cleaning surface, wherein the debris collection unit is fluidly connected to the beater bar housing.

4. The surface cleaning apparatus of claim **3**, further comprising wheels, wherein the beater bar is driven by the frictional force of the wheels on the cleaning surface.

5. The surface cleaning apparatus of claim **1**, further comprising a temperature sensor in thermal contact with the steam generator, wherein the temperature sensor enables water flow to the steam generator when a minimum temperature within the steam generator is reached.

6. The surface cleaning apparatus of claim **1**, further comprising a temperature sensor in thermal contact with the steam generator, wherein the temperature sensor shuts off power to the heater when a maximum temperature within the steam generator is reached.

7. The surface cleaning apparatus of claim **1**, further comprising a steam inlet of the second chamber disposed above the water inlet of the steam generator when the steam generator is disposed in the surface cleaning apparatus.

8. The surface cleaning apparatus of claim **7**, wherein the water entering from the water inlet into the first chamber flows away from the steam inlet.

9. The surface cleaning apparatus of claim **7**, wherein the steam outlet is disposed outside the first chamber and the steam inlet is disposed proximate the water inlet.

10. The surface cleaning apparatus of claim **1**, wherein the water inlet is substantially orthogonal to the first chamber.

11. The surface cleaning apparatus of claim **1**, wherein the first chamber is substantially cylindrical in shape.

12. The surface cleaning apparatus of claim **1**, wherein the second chamber is substantially cylindrical in shape.

13. The surface cleaning apparatus of claim **1**, wherein the first chamber comprises a non-corrosive heat conductor.

14. The surface cleaning apparatus of claim **1**, wherein the second chamber comprises polytetrafluoroethylene.

15. The surface cleaning apparatus of claim **1**, wherein the second chamber comprises a non-corrosive heat conductor.

16. The surface cleaning apparatus of claim **1**, further comprising a thermal insulator disposed around the first chamber.

17. The surface cleaning apparatus of claim **1**, wherein water entering from the water inlet into the first chamber flows toward the steam outlet.

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